American Marten: A mammal barometer of global climate change

by Andy Baltensperger

Global climate change is increasing recognized as a powerful force reshaping the environment in recent decades. Climate change raises many new questions which challenge traditional views of wildlife management, such as how will altered climate affect various wildlife species, how will it change ecosystem functions, and ultimately, how should we manage ecosystems within this constantly shifting climatic framework?

The American marten (*Martes americana*) is one species whose strict physiological requirements in winter make it especially for monitoring for climate warming. Marten are very sensitive to environmental conditions and should be a good indicator species for detecting environmental change. This sensitivity however does not necessarily allow a straight-forward prediction of the marten response to climate change.

On the Kenai Peninsula, marten are most abundant within the denser, wetter forests of the eastern Kenai, and they extend westward along forested drainages through the Kenai Mountains to Skilak Lake. They are not typically found within the black spruce dominated Kenai lowlands where canopy cover is sparse and where snow depths are generally lower than in the Kenai Mountains.

For an animal which traditionally inhabits boreal forests, marten are physiologically rather poorly equipped to deal with winter. Marten have long, slender heat-radiating bodies, poorly insulative fur, low fat reserves, high metabolic requirements, and do not hibernate. All of these factors combine to make survival during cold winters a struggle for marten.

The reason marten have been able to exploit boreal forest habitats so successfully is their ability to seek out thermodynamically efficient resting sites. In winter, because of their physiological vulnerability to cold, marten must rest under an insulating layer of snow in order to stay warm. Pieces of course-woody debris (downed trees, logs, stumps, etc) protrude up through the snow and create pockets and tunnels where marten can easily access the subnivean zone (space between the snow surface and ground). In the subnivean zone, marten rest under the wood, which keeps them dry, while the snow overhead insulates them from cold temperatures outside.

A layer of fresh snow at least eight inches deep is sufficient for maintaining resting site temperatures between approximately 10 and 32°F, even when outside temperatures approach -40°F. This critical depth increases linearly, however, as the snow layer becomes older and denser with thawing and refreezing, which is occurring more frequently during Kenai winters nowadays. If snow depths and densities do not meet insulative thresholds, marten have to capture additional prey simply to stay warm or they will freeze to death. Thermodynamic stress and unavailable prey are both related to inconsistent snow-cover and are probably highly significant factors controlling the distribution of marten on the Kenai.

If snow depths are in fact limiting marten distribution, there are several alternate scenarios which may play out as the climate becomes warmer. Under one scenario, climate warming may actually increase winter snowfall the Kenai, in which case suitable winter marten habitat may expand into the lowlands. On the other hand, despite any potential increase in snowfall, an accompanying increase in winter thawing may destroy the insulative capacity of snow for marten in many areas of the Kenai. A third, long-term scenario involves significant warming to the extent that winter lows no longer fall below 0°C. In this case marten would better optimize their heat conservation by resting above the snow, when it is present. Under such extreme warming conditions (unlikely in the near future), snow cover would cease to be a requirement for marten survival on the Kenai.

There are other factors in addition to snow-cover which should be considered. Marten tend to prefer older, closed-canopy forests, which have more prey, more course woody debris, and better protection from predators than do open-canopy forests. On the Kenai Peninsula, mature forests include hemlock, white spruce, Lutz spruce, and Sitka spruce forests, but generally exclude areas of black spruce which tend to

lack a closed canopy. Recent research on the Kenai indicates an upward movement of tree-line at a rate of approximately one meter per year since the 1950s. As closed-canopied forests continue to move upward into areas of alpine tundra, marten habitat should expand upward into higher elevations already having sufficient snow-cover.

Over the next two winters as part of my graduate thesis research, I plan to examine marten distribution patterns and their relationships with average snow depth across the Kenai. My working hypothesis is that marten have been restricted from dispersing into the Kenai lowlands and other areas of suitable habitat by the lack of sufficient snow-cover. A recent study of museum specimens from the Kenai indicates that marten and shrew body sizes have increased slightly in size over the past 100 years, which suggests a positive response to greater food availability due to climate warming.

It will be interesting in the coming decades to monitor exactly how marten populations respond to a host of hanging factors such as snow-depths, temperatures, tree-line, and prey availability as their habitat changes with our warmer climate.

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